M.Sc.Geoinformatics

SYLLABUS

(Revised Syllabus w.e.f the academic year 2021-22 under the CBCS)

CENTRE FOR GEOINFORMATICS

The Gandhigram Rural Institute (Deemed to be University)

(Ministry of Education, Govt. of India)

Accredited by NAAC with 'A' Grade (3rd Cycle)

Gandhigram – 624 302

Dindigul District, Tamil Nadu

I.Programme Code : GISP

II.Programme : M.Sc. Geoinformatics

III. Programme Educational Objectives (PEO)

PEO1: to assess the spatial distribution of natural resources using tools of Geoinformatics.

PEO2: to succeed in getting employment in their field of interest / related areas of RS/ GIS.

PEO3: to grow in their professional career through higher education in the areas of GIS/ RS/ GPS and software development.

PEO4: to cater to the needs of the industry in order to contribute for the development of the society

PEO5: to become a consultant

IV. Graduate Attributes for M.Sc.Geoinformatics (GA)

1. Computational Knowledge:

In the area of natural resource and disaster management, they can apply the tools/ techniques of Geoinformatics.

2. Geospatial problem Analysis:

For the problems related to natural resource and disaster management, they can identify, formulate, review and solve, by which they can provide a valid solutions using the tools/techniques of Geoinformatics.

3. Design /Development of Solutions:

For complex geospatial problems in the area of natural resource management, they can design and evaluate solutions. Similarly, they can evolve models that can meet specified needs with appropriate consideration for rural development in general and public health and safety, cultural, societal and environmental considerations in particular.

4. Conduct Investigations of Complex Geospatial Problems:

In case studies, internship and dissertation they experiment, analyse and interpret the data to provide valid alternate solutions. Thus adopts research-based knowledge and research methods.

5. Professional Ethics:

Understand and commit to professional ethics.

6. Life-long Learning:

As a Geoinformatics professional, as per the requirement and need, they have the ability to learn independently for periodic updating.

7. Communication Efficacy:

They are capable to communicate effectively with the professional community and also with the society; as they are able to understand clear instructions, comprehend and write effective reports, design documentation and make effective presentations.

8. Societal and Environmental Concern:

Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional practice.

9. Individual and Team Work:

They can function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

10. Innovation and Entrepreneurship

They can use innovation to pursue an opportunity to create value and wealth for the betterment of the society in serve and an individual in particular.

V. Programme Outcomes (PO)

PO1: Become knowledgeable in the use of tools of Geoinformatics and apply them to the needs of the Employer / Institution / Enterprise / Society.

PO2: Gain hands on experience in Digital Image Processing (DIP), GIS, GPS and Programming / scripting languages

PO3: Analyze the problems associated with natural resource and disaster management

PO4: Develop tools / software in analyzing the issues in Natural Resource and Disaster Management

PO5: Acquire knowledge in designing a GIS to gain field experience in identifying and analyzing problems related to natural resources/ disasters at various levels.

VI. Programme Specific Outcome (PSO)

PSO1: Map the natural resources/ disaster using tools of Geoinformatics

PSO2: Inventory of rural resource using Geoinformatics to solve natural resource related issues at various levels.

PSO3: Apply the knowledge of Geoinformatics in the domain of identification and solving of natural resource problems

PSO4: Design new tools/ tool bars and customize software to analyse natural resoure data using Programming/ scripting languages along with the use of open source data and software

PSO5: Selection and evaluation of tools and techniques of Geoinformatics and their suitability for natural resource/ disaster management.

Eligibility: A pass in UG degree in Sciences, Engineering and Technology disciplines.

VIII. Scheme of Examination of the Programme

M.Sc. Geoinformatics

(Revised Syllabus w.e.f the Academic year 2021 – 2022 under the CBCS)

Semester	Category	Course Code	Title of the Course	K	No. of Credits	Theory (hours)	Practical (hours)	Duration of ESE (Hours)	Evaluation Marks		Total Marks
									CFA	ESE	
I	Major Courses	21GISP0101	Introduction to Geoinformatics	2-4	4	4		3	40	60	100
		21GISP0102	Cartography	2-4	4	4		3	40	60	100
		21GISP0103	Geographical Information System	2-6	4	4		3	40	60	100
		21GISP0104	Programming Languages for Geoinformatics	2-6	4	4		3	40	60	100
		21GISP0105	Practical - I: Geographical Information System	3-6	2		4	3	40	60	100
		21GISP0106	Practical - II: Programming Languages for Geoinformatics	2-6	2		4	3	60	40	100
	VAC	21GTPP0001	Gandhi in Everyday Life	2-3	2	2	-	-	50	-	50
				Total	**22**	**18**	**8**	**-**			
II	Major Courses	21GISP0207	Remote Sensing and Photogrammetry	2-4	4	4	-	3	40	60	100
		21GISP0208	Digital Image Processing	2-5	4	4	-	3	40	60	100
		21GISP0209	Spatial Data Science	3-4	4	4	-	3	40	60	100
		21GISP0210	Practical -III: Remote Sensing, Digital Image Processing and Photogrammetry	2-6	2		4	3	60	40	100
		21GISP0211	Practical -IV: Spatial Data Science	2-6	2		4	3	60	40	100
	MC	21GISP00MX	Modular Course	3-6	2	2			50	-	50
	EG		Elective - Generic	4-5	3	3		3	40	60	100
	VAC	21ENGP00C1	Communication / Soft Skills		2	2		-	50	-	50
	VAC	21GTPP00H1	Human Value and Professional ethics		2	2		-	50	-	50
				Total	**25**	**21**	**8**	**-**			
III	Major Courses	21GISP0312	Global Navigation Satellite System	2-6	3	3		3	40	60	100
		21GISP0313	Geoinformatics in Resource Management	2-6	4	4		3	40	60	100
		21GISP0314	Geoinformatics in Disaster Management	2-6	3	3		3	40	60	100
		21GISP0315	Practical -V: Geoinformatics in Resources and Disaster Management	2-6	2		4	3	60	40	100
		21GISP0316	Practical -VI: Case Study in GIS / RS/ Web GIS	3-6	2		4	3	60	40	100
		21APRP0101	Research Methods and Statistics	4-6	4	4		3	40	60	100
	DC	21GISP03DX	Elective – Discipline Centric	3-6	3	3	-	3	40	60	100
	VPP	21GISP03V1	Village Placement Programme	5-6	2		-	-	50	-	50
	MC	21GISP00MY	Modular Course	3-6	2	2	-		50	-	50
				Total	**25**	**19**	**8**	**-**			
IV	**Major**	21GISP0417	Dissertation *	5-6	6		**12**		75	125	200
		21GISP0418	Internship**	5-6	12		**24**		200	-	200
				Total	**18**	**-**	**36**				
				Grant Total (I + II + III + IV)	**90**	**58**	**60**				

Major Course

Semester	Course Code	Title of the Course	No. of Credits
I	21GISP0101	Introduction to Geoinformatics	4
	21GISP0102	Cartography	4
	21GISP0103	Geographical Information System	4
	21GISP0104	Programming Languages for Geoinformatics	4
	21GISP0105	Practical - I: Geographical Information System	2
	21GISP0106	Practical - II: Programming Languages for Geoinformatics	2
		Total	**20**
II	21GISP0207	Basics of Remote Sensing and Photogrammetry	4
	21GISP0208	Digital Image Processing	4
	21GISP0209	Spatial Data Science	4
	21GISP0210	Practical -III: Remote Sensing, Digital Image Processing and Photogrammetry	2
	21GISP0211	Practical -IV: Spatial Data Science	2
		Total	**16**
III	21GISP0312	Global Navigation Satellite System	3
	21GISP0313	Geoinformatics in Resource Management	4
	21GISP0314	Geoinformatics in Disaster Management	3
	21GISP0315	Practical -V: Geoinformatics in Resources and Disaster Management	2
	21GISP0316	Practical -VI: Case Study in GIS / RS/ Web GIS	2
	21APRP0003	Research Methods and Statistics	4
		Total	**18**
IV	21GISP0417	Dissertation *	6
	21GISP0418	Internship**	12
		Total	**18**
Grant Total (I + II + III + IV)			**72**

Elective - Discipline Centric

Discipline Centric courses - 21GISP03DX	
21GISP03D1	Earth, Atmospheric, Ocean and Planetary Sciences
21GISP03D2	Geoinformatics for Watershed Management
21GISP03D3	Web Technology for Geoinformatics
21GISP03D4	Google Earth Engine for Remote Sensing Applications

Modular Course

Modular Course 21GISP00MX / MY	
21GISP00M1	Spatial Decision Support System
21GISP00M2	Open Source Software
21GISP00M3	LiDAR and its Applications
21GISP00M4	Drone Image Processing

Value Added Courses

VAC 21GISP2VAX	
21GISP2VA1	Advanced Surveying
21GISP2VA2	Planetary Remote Sensing
21GISP2VA3	Satellite Meteorology

Name of the Programme	**M.Sc. Geoinformatics**										
Year of Introduction	2002				Year of Revision				2021		
Semester-wise Courses and Credit distribution	I	II	III	IV	V	VI	VII	VIII	IX	X	**Total**
No. of Courses	7	9	9	2	-	-	-	-	-	-	**27**
No. of Credits	22	25	25	18	-	-	-	-	-	-	**90**

Semester	I	**Course Code**	**21GISP0101**
Course Title	**Introduction to Geoinformatics**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	45%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • introduce Geoinformatics as an advanced tool consisting of various modern advanced technologies used for mapping and managing the earth resources.		

UNIT	Content	No. of Hours
I	Earth – Origin, Interior, Age, size, shape and Physiography. Atmosphere: Origin and nature, Composition and layers of the atmosphere. Hydrosphere and lithosphere constituents.	10
II	Geodetic information - lat - long - time – altimetry. Basic principles of surveying – Classification and applications- Scales - Conventional signs - Land Surveying - Various Levels, Leveling methods, Compass, Theodolite and Total Station and their uses, Tachometer, Trigonometric leveling, Traversing, Triangulation and Trilateration.	15
III	Meaning and Scope of Geoinformatics – Science and Technologies involved: Remote Sensing- Geographical Information System- Digital Image Processing - Photogrammetry - Geodesy- Global Positioning System - Information & Communication Technologies	15
IV	Aerial and Satellite based survey techniques - Photogrammetry, RADAR, LiDAR –UAV - Survey by GNSS. Geodata visualization and analysis	10
V	Application of Geoinformatics: Rural Development, Geosciences, Agriculture, Forestry, Soil Studies, Meteorology, Military, Civil Engineering, Transport, Environmental studies, Banking, Health, Telecommunication, Electricity, Oil & Gas Industries etc.,	10
References	Text Books: 1. Chandra A.M., Geoinformatics, New Age International Publishers, New Delhi, 2016. 2. LO. C.P., and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi, 2006.	

	Reference Books: 1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015. 2. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt .Ltd., New Delhi, 2017. 3. Arthur H. Robinson et al. Elements of Cartography (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2016. 4. Misra, R.P.and Ramesh, A, Fundamentals of Cartography, Concept Publishing Company, New Delhi, 2002. 5. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017.
	E-Resources: 1. https://courses.lumenlearning.com/geophysical/chapter/the-composition-and-structure-of-earth/ 2. https://www.britannica.com/topic/evolution-of-the-atmosphere-1703862 3. https://ncert.nic.in/textbook/pdf/kegy303.pdf 4. http://bbsbec.edu.in/wp-content/uploads/2020/01/com.pdf 5. http://www.gitta.info/Generalisati/en/image/Signs.pdf 6. https://www.icsm.gov.au/education/fundamentals-mapping/surveying-mapping/surveying-methods 7. https://www.researchgate.net/publication/291833102_GIS_Scope_and_Benefits 8. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/remote-sensing-technology 9. http://sdeuoc.ac.in/sites/default/files/sde_videos/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez%2C%20R.%20Woods-ilovepdf-compressed.pdf 10. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/photogrammetry
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the basic information about to earth, atmosphere and principles of acquiring earth related information CO2. Understand the meaning, scope and science & technologies involved in Geoinformatics. CO3. Understand and analyze the basics principles of surveying using conventional and modern tools and technologies CO4. Apply various methods of Geodata visualization for analysis. CO5. Apply tools of Geoinformatics in various applications.

Mapping of COs with PSOs :

CO	PSO				
	1	2	3	4	5
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	2	2	2	2	2
CO 5	3	3	3	3	3

Semester	I	**Course Code**	**21GISP0102**
Course Title	**Cartography**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	30%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • help the students to know about the basic principles and importance of cartography, map projection, data visualization, map design and layout and various techniques of map production and reproduction.		

UNIT	Content	No. of Hours
I	Cartography: Definition – nature, scope and its role – Concept of map – Principles of Cartography – Characteristics, Components and types of map – Map Compilation and generalization.	10
II	Map projection: Concept – classification – uses and types of projection: Conical – Azimuthal - Cylindrical – map scale.	11
III	Data/Information – database – Visualization of data: symbolization – 2D visualization (mapping techniques) – 3D visualization (TIN, DEM, DSM, DTM, Hill Shading, Hatching, visibility analysis, slope, aspect) – 4D visualization (creation of movies, animation) – virtual reality map – issues in visualization.	10
IV	Definition of map design and layout – Overall map designing: Elements – Internal map designing: Components – Methods of map reproduction – various ways of sharing of geospatial data with users. Map appreciation and interpretation.	8
V	Introduction to Digital Cartography: Adaptation of Computer in Cartography – History – Components of Digital Cartography - Benefits – disadvantages of digital cartography - Conventional mapping Vs Digital Mapping; Web cartography. Nano cartography.	9
References	Text Books : 1. Arthur H. Robinson et al. Elements of Cartography (6th Edition), Wiley India Pvt. Ltd., New Delhi, 2016.	

	Reference Books: 1. LO, C.P. and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi, 2006. 2. Misra, R.P. and Ramesh, A., Fundamentals of Cartography, Concept Publishing Company, New Delhi, 2002. 3. Cartwright .W, Gartner G. ALehn (Eds.), Cartography and Art, Springer – Verlag Berlin Heidelberg, 2009.
	E-Resources 1. Fundamentals of General Cartography, http://164.100.133.129:81/econtent/Uploads/Fundamentals_of_General_Cartography.pdf 2. Elements of Cartography by Arthur H. Robinson, http://rapidshare.com/files/685095396/Elements.of.Cartography.rar 3. Cartography – a tool for spatial analysis, https://www.pdfdrive.net/cartography-a-tool-for-spatial-analysis-d39693639.html 4. Map Projection, https://pubs.usgs.gov/pp/1395/report.pdf.
Course Outcomes	On completion of the course, students should be able to do CO1. Explain the basic principles of cartography and interpretation of maps CO2. Choose appropriate projection for a map CO3. Select a method of data collection and visualization CO4. Construct a map with design and layout principles CO5. Apply the computers in digital map making on web

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	1	1	2
CO 2	3	2	1	1	3
CO 3	3	2	1	1	2
CO 4	3	3	1	1	3
CO 5	3	2	1	1	2

Semester	I	**Course Code**	**21GISP0103**
Course Title	**Geographical Information System**		
No. of Credits	**4**	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	40 %
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • provide knowledge on various methods of data input, types of errors and its correcting methods. • gain knowledge on GIS analysis, GIS data modeling, • know about various forms of GIS output and their method of visualization		

UNIT	Content	No. of Hours
I	GIS: Definition – components – characteristics of Spatial Data – sources of GIS data - spatial data models/ structure - raster and vector – representation of spatial data in GIS: Layer based – tile based – object oriented based.	7
II	Data Input methods: Keyboard – scanning – digitization: manual – semi-automatic – automatic, – electronic data transfer. Errors in Spatial data and attribute data – edge matching - rubber sheeting. Integration of spatial and non-spatial (attribute) data.	9
III	Vector Analysis: Measurement – Query – Buffer – MCE: Estimation of weights: ranking – rating – pair-wise comparison method - Overlay. Network modeling: Arc – Node – vertices – Analysis: travelling sales person problem – location-allocation modeling – route tracing – service area – closest facility – OD cost matrix.	10
IV	Raster Analysis: Measurement – Reclassification - Overlay. Spatial interpolation: TIN – Thiessen Polygon – trend surface - Spatial moving average– extrapolation. Surface modeling: DEM – Slope – Aspect - Hill Shade – visibility/ view-shed analysis - curvature. Hydrological Analysis: Fill – flow direction – flow accumulation – flow length – basin.	12

	Building an integrated database: Weighted overlay – weighted sum – fuzzy membership – fuzzy overlay	
V	Model building - Cartographic Output: Maps as output – cartograms: definition – types of cartograms - non-cartographic output: Tables and Charts – Linked display – spatial multimedia – delivery mechanism: Hardcopy output – softcopy output: monitors – slide shows – virtual reality - map as a decision tool.	10
References	Text Books: 1. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt. Ltd., New Delhi, 2017.	
	Reference Books: 1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015. 2. Kang-tsung Chang, Introduction to Geographic Information Systems (4th Edition), McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2013. 3. John R. Jensen and Ryan R. Jensen, Introductory Geographic Information Systems, Pearson Education Pvt. Ltd., New Delhi, 2018. 4. LO. C.P., and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi, 2006. 5. M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems (4th Edition), BS Publications, Hyderabad, 2019.	
	E-Resources: 1. Michael J de Smith, Michael F Goodchild and Paul A Lougley, Geospatial Analysis (6th Edition), 2020, https://spatialanalysisonline.com/HTML/index.html 2. Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, 2016, https://www.pdfdrive.com/gis-fundamentals-a-first-text-on-geographic-information-systems-e188660361.html 3. Michael D. Kennedy, Michael F. Goodchild & Jack Dangermond, Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, 2013, https://www.pdfdrive.com/introducing-geographic-information-systems-with-arcgis-a-workbook-approach-to-learning-gis-e156925406.html	
Course Outcomes	On completion of the course, students should be able to do CO1. Explain the basics of GIS CO2. Discuss the various methods of data input and editing. CO3. Identify and produce different GIS output CO4. Analyze, evaluate and create various GIS based models.	

Mapping of Cos with PSOs:

CO	PSO				
	1	2	3	4	5
CO 1	1	1	1	1	1
CO 2	1	1	2	1	1

CO 3	3	3	2	1	3
CO 4	2	2	2	1	2
CO 5	2	2	2	1	2

Semester	I	Course Code	**21GISP0104**
Course Title	**Programming Languages for Geoinformatics**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	80%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Offer Object Oriented Programming concepts in python and basic knowledge on Machine Learning and Deep Learning.		

UNIT	Content	No. of Hours
I	Introduction OOPS Concept – Application of OOPS –Introduction - Variables - Expressions - Statements - Operators - Functions - Conditionals and Recursion - Fruitful Functions.	10
II	Iteration- Strings - Lists - Tuples - Dictionaries - Files and exceptions. Library : Geemap - Arcpy- Pandas - Geopandas - Geemap - RSGISLib - GDAL/OGR - Folium - ipyleaflet - Scikit - Matplotlib - NumPy - PyProj- PyTorch - Keras - TensorFlow - Theano – SciPy – LiDAR. Reading Satellite images.	10
III	Class and objects - Class and methods - Sets of objects - Inheritance - Linked lists - Stacks - Queues – Trees.	10
IV	Foundation of Machine Learning - Data Pre-Processing - Supervised Learning: Introduction -Linear Regression-Logistic Regression - Naive Bayes. Unsupervised Learning - Introduction - Clustering - Principal Component Analysis - Single Value Decomposition. GIS in Machine Learning.	9
V	Deep Learning - Foundation - Fundamental - Deep Learning from Scratch - Convolutional Neural Network (CNN) - Recurrent Neural Networks (RNN) - Deep Belief Networks (DBN) - GIS in Deep Learning.. GIS applications in DL.	9

References	Text Book 1. 1How to Think like a Computer Scientist Learning with Python, Allen Downey, Jeffrey Elkner and Chris Meyers, Green Tea Press.

	Reference Books: 1. Machine learning algorithms using python programming, Gopal Sakarkar, Gaurav Patil And Prateek Dutta, Nova Publisher. 2. Deep Learning - Foundation - Fundamental - Deep Learning from Scratch - Convolutional Neural Network (CNN) - Recurrent Neural Networks (RNN) - Deep Belief Networks (DBN) - GIS in Deep Learning. 3. E.Balagurusamy, Introduction to Computing and Problem Solving Using Python, McGraw Hill Education (India) Pvt. Ltd., Chennai, 2016. 4. Reema Thareja, Problem Solving and Programming with Python, Oxford University Press, New Delhi, 2018. 5. Allen B.Downney, Think Python (2nd Edition), Shroff Publishers & Distributors Pvt. Ltd., New Delhi, 2019. 6. Michael Bowled, Machine Learning in Python, Wiley India Pvt.Ltd, New Delhi, 2015. 7. Guida Van Rossum et al., An Introduction to Python, Shroff Publishers & Distributors Pvt. Ltd., New Delhi, 2019
	E-Resources: 1. ArcPy and ArcGIS, http://www2.arinigeo.com/wp-content/uploads/2016/05/ArcPy-and-ArcGIS-Geospatial-Analysis-with-Python-by-Silas-Toms.pdf 2. Programming ArcGIS 10.1 with Python Cookbook, http://pdf.th7.cn/down/files/1312/Programming%20ArcGIS%2010.1%20with%20Python%20Cookbook.pdf 3. Python, http://www.davekuhlman.org/python_book_01.pdf 4. Python Scripting for ArcGIS , http://darrylmcleod.com/wp-content/uploads/2016/06/Python-Scripting-for-ArcGIS.pdf
Course Outcomes	On completion of the course, students should be able to do CO 1. Understand the basic concepts of object oriented programming CO 2. Write simple programs using Python. CO 3. Understand advanced concept of Python CO 4. Understand Machine Learning Algorithms 5. CO5. Understand Deep Learning Algorithms

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	2	3	4	5
CO 1	1	2	3	2	3
CO 2	2	2	3	2	3
CO 3	1	3	2	3	3
CO 4	1	2	3	3	3
CO 5	1	3	2	1	2

Semester	I	**Course Code**	**21GISP0105**
Course Title	**Practical – I: Geographical Information System**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	40 %
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • apply the tools of AutoCAD and ArcGIS in creating, analyzing and evaluating geospatial data, create a model and to design map and layout		

UNIT	Content	No. of Hours
I	Surveying: Total Station - DGPS.	10
II	Introduction to commercial and open source GIS software. (AutoCAD, ArcGIS, QGIS etc) Map Appreciation - Map interpretation – spatial entities – data dictionary. Georeferencing - projections – Database creation. Spatial and attribute data entry, editing and joining them.	12
III	Working with tables and layer properties. Methods of data analysis I: Measurement - Buffer – overlay– spatial interpolation – reclass – TIN – DEM. Methods of data analysis II: Network – surface – hydrology.	15
IV	Map algebra – MCE - Building models - Map Design and Layout	15
V	Creation of tool bar – introduction to ArcPY – generating python scripts from Model Builder.	10
Course Outcomes	On completion of the course, students should be able to CO1. Apply total station and DGPS for surveying CO2. Apply the tools of AutoCAD, ArcGIS, QGIS etc. CO3. Analyze the data in GIS with appropriate tools CO4. Create new models	

	CO5. Design and layout a map

Mapping of Cos with PSOs :

CO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	1	3	2	3	3
CO 2	1	3	2	3	2
CO 3	1	3	2	3	2
CO 4	1	3	2	3	3

Semester	I	**Course Code**	**21GISP0106**
Course Title	**Practical – II: Programming Languages for Geoinformatics**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	New	If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • import basic programming knowledge using Python for Geoinformatics. • Provide basic knowledge on GDAL to read GIS image files Python. • Provide basic knowledge on Ipyleaflet in python.		

UNIT	Content	No. of Hours
I	**<u>Python Programming</u>** 1. Operators 2. Decision statements (if- else, switch) 3. Basic Loop operations 4. Strings 5. Math Functions and IO functions 6. Functions 7. Recursion Function 8. File Operations 9. Class and Objects 10. Constructor 11. Overloading (Functional and Operator) 12. Inheritance 13. Exception Handling 14. Modules 15. List 16. Tuple 17. Dictionaries 18. Stacks 19. Queues 20. Linked List	20

	21. Trees	
II	**GDAL Libraries** 1. File Reading Operations 2. Satellite Image Reading 3. Manipulation on Satellite Images	15
III	**Ipyleaflet Libraries** 1. Simple Map reading 2. Simple Map operations 3. Adding marks on a Map	15
Course Outcomes	On completion of the course, students should be able to do CO1. Develop programs using decision making, functions, Class, Inheritance, Data structures and in Python CO2. Write Python programming for GDAL Libraries CO3. Write Python programs for IpyLeaflet Libraries	

Mapping of Cos with PSOs :

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	1	3	2	3	3
CO 2	2	3	2	1	3
CO 3	2	1	3	3	2

SEMESTER – 2
First Year

Semester	II	**Course Code**	**21GISP0207**
Course Title	**Remote Sensing and Photogrammetry**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	30%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • understand the basic concepts of remote sensing and photogrammetry • understand the systems and techniques of data acquisition, LiDAR, Hyperspectral remote sensing and data products of different satellites.		

UNIT	Content	No. of Hours
I	History and development - Electro Magnetic Spectrum - Components and types of remote sensing – Energy interaction with atmosphere and Earth features - Resolutions (Spectral, Spatial, Temporal & Radiometric) - Platforms – Sensors - Scanning & Orbiting Mechanism of Satellites and Data Acquisition. - Optical Remote Sensing: Basic concepts - Optical sensors and scanners Image interpretation – Visual Interpretation elements	10
II	Historical development - definition – types – Sensors -Planning and execution- Geometry of vertical aerial photograph, scale of vertical aerial photograph, relief displacement. - Stereoscopic parallax - Aerial triangulation –Ortho photograph generation - Digital photogrammetry	10
III	Thermal Remote Sensing: Basic concepts - Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basic concepts - Microwave sensors and Radiometers - Geometric characters. RADAR – Radargrammetry (SLAR & SAR) – Missions : RISAT, RADARSAT, Sentinel 1A&1B, NISAR, ALOS PALSAR – SRTM LiDAR – LiDAR system - components - operating principles— LiDAR data characteristics – advantages.	10
IV	Hyper spectral Remote Sensing: basic concepts hyperspectral sensors, data formats and systems, AVIRIS, CASI, MODIS and Hyperion. Lunar Remote Sensing – Mars Mission.	8
V	Types of satellites – environmental, resource survey satellites,	10

	weather and communication satellites, GPS satellites and Shuttle Mission - Major satellite systems: Sensors and data products of IRS, LANDSAT, SPOT, ERS, IKONOS, Quik Bird, ORBVIEW, WORLD VIEW and others – UAV and low altitude payloads in different spectral regions.	
References	Text Books (with chapter number & page number, wherever needed): 1. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017. 2. Paul R. Wolf., Elements of Photogrammetry, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2014.	
	Reference Books: 1.Basudeb Bhatta, Remote Sensing and GIS (2nd Edition), Oxford University Press, New Delhi, 2017. 2.John R.Jensen, Remote Sensing of the Environment: An Earth Resource Perspective (2nd Edition), Pearson India Education Services Pvt Ltd, Noida, 2018. 3.Ravi P. Gupta, Remote Sensing Geology (2nd Edition), Springer (India) Pvt. Ltd., 2014. 4.M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems (4th Edition), BS Publications, Hyderabad, 2019. 5.Chandra A.M and Ghosh. S.K., Remote Sensing and Geographic Information System (2nd Edition), Narosa Publishing House Pvt. Ltd., New Delhi, 2017. 6.Mikhail et al., Introduction to Modern Photogrammetry, Wiley India Pvt..Ltd, New Delhi,2013.	
	E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.) 1. https://ncert.nic.in/textbook/pdf/kegy307.pdf 2.https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf 3.https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesremotesensing.pdf 4.https://www.electronicshub.org/different-types-sensors/ 5.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M027029/ET/1517207018AERIALPHOTOGRAPHY(2.pdf 6.https://www.slideshare.net/virajain/lecture-1aerial-photogrammetry 7.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M028382/ET/1521702258Divyani_Digi_Photogrammetry(2.pdf 8.https://earth.esa.int/documents/973910/1002056/CK3.pdf/4e5b4e5a-d898-43b8-9e5c-ba7494aa58c8 9.http://www.geoinformatie.nl/courses/gima_rs/Day%203/GIMA%20ch4%20Microwave%20Remote%20Sensing.pdf 10.https://www.sciencedirect.com/topics/earth-and-planetary-sciences/side-looking-radar	
Course Outcomes	On completion of the course, students should be able to CO1. Understand the basic concepts of remote sensing. CO2. Understand aerial photography, types, planning and execution. CO3. Apply different photogrammetric techniques. CO4. Understand the basics of LiDAR, RADAR, Microwave remote sensing and its principles. CO5. Understand various satellite and sensors.	

Mapping of Cos with PSOs :

CO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	3	3	3	1	1
CO 5	2	2	2	1	1

Semester	II	Course Code	**21GISP0208**
Course Title	**Digital Image Processing**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	25%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate)		
Course Objectives (Maximum: 5)	The Course aims to • apply the concept of digital image processing techniques • analyze the digital data • evaluate and create information on Earth using digital data		

UNIT	Content	No. of Hours
I	Digital Data: Basic Characteristics of digital image - data type and file format. Data acquisition and interpretation - Image display systems - Image sampling and quantization - Basic relationship between pixels - data merging - image transmission and compression.	8
II	Digital Image Processing: Introduction - stages in digital image processing - Preprocessing: geometric correction, atmospheric correction and radiometric correction	10
III	Image Enhancement: stretch, Single Band Enhancement (Image reduction & Magnification, Contrast Stretching, Filtering & Edge enhancement) - Multiband Enhancement (Band rationing, color composite generation, Principal Component Analysis, NDVI, NDWI & other indices).	9
IV	Image Classification: Unsupervised classification - Supervised classification technique - training sites - classification stage - minimum distance to mean classifier – parallelepiped classifier - maximum likelihood classifier - Hybrid Classification – Sub Pixel Classification - Fuzzy Classification - accuracy assessment- post classification smoothing change detection procedures	13
V	Hyperspectral Image Processing: Data cube, Hyperspectral Profiles, Data Redundancy, - Problems with Dimensionality, Principal Component, Minimum Noise Fraction (MNF) - Atmospheric Correction, Pixel Purity Index, Empirical line Calibration - Reflectance Transformation, Continuum Removal - Spectral feature Fitting,	8

	Spectral Angle mapper & SVM. Microwave Image Processing	
References	Text Books: 1. John R Jenson, "Introducing Digital Image Processing", Prantice Hall. New Jersy 1986. 2. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017.	
	Reference Books: 1. Jensen R. John, Remote Sensing of the Environment An Earth Resource Perspective, Pearson Education Pvt. Ltd., Delhi, 2006. 2. Gibson, Paul.J. and Clare H. Power, Introductory Remote Sensing: Digital Image Processing and Applications, Routledge, London, 2000. 3. Milman S. Andrew, Mathematical Principles of Remote Sensing making Inferences from Noisy Data, Ann Arbor Press, Noida, 1999. 4. Paul J. Curran, Principles of Remote Sensing, English Language Book Society, Longman, 1985. 5. John A. Richards, Springer-Verlag, Remote Sensing Digital Image Analysis, 1999. 6. Digital Image Processing (3rd Edition) Rafael c.Gonzolez, Richard E.Woods Prentice Hall, 2007.	
	E-Resources: 1. https://www.youtube.com/watch?v=hhddNZloKWs 2. https://www.youtube.com/watch?v=H0MQ287871o 3. https://www.iare.ac.in/sites/default/files/lecture_notes/DIP-LECTURE_NOTES.pdf 4. https://www.mtholyoke.edu/courses/tmillett/course/geog205/files/remote_sensing,pdf 5. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200402191015688 3ajay_misra_geo_Digital_Image_Processing.pdf 6. https://www.ques10.com/p/33595/what-is-image-processing-explainfundamental-steps/ 7. https://sisu.ut.ee/imageprocessing/book/6coursesonline.iasri.res.in/mod/page/view.php?id=2065 8. .file:///C:/Users/admin/Downloads/HyperspectraRemoteSensingDataAPracticalManual_20131.pdf 9. https://www.l3harrisgeospatial.com/Company/News/NewsDetail/ArtMID/11139/ArticleID/23460/The-Science-and-Art-of-Hyperspectral-Image-Analysis 10. https://sisu.ut.ee/imageprocessing/book/6coursesonline.iasri.res.in/mod/page/view.php?id=2065	
Course Outcomes	On completion of the course, students should be able to do CO1. Understand digital data, format, acquisition and interpretation of various remotely sensed satellite images CO2. Understand maps preprocessing and enhancement. CO3. Understand various image classification techniques CO4. Understand various DIP techniques used in Hyperspectral Images. CO5. Understand various outputs and other techniques.	

Mapping of Cos with PSOs:

CO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	2	2	2	1	1
CO 5	2	2	2	1	1

Semester	II	Course Code	**21GISP0209**
Course Title	**Spatial Data Science**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Core Course		
Scope of the Course (may be more than one)	• Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • provide the concept o Data Science, Basic Statistics, Spatial Data Base Management System and Spatial Data Science. • provide R programs for Data Science • provide point pattern analysis.		

UNIT	Content	No. of Hours
I	Introduction Data Science – Components – Process – Roles – Tools – Applications - Problems in Data Science - Spatial Data Science. Exploratory Data Analysis. Statistics for Data Science - Linear Regression - Multiple Regression - Normal Distribution - Binomial Distribution - Time Series Analysis - Decision Tree - Random Forest.	10
II	Database Management System(DBMS) - Spatial Database Management System(SDBMS) - Big Data System , MapReduce - Big Data System, Hadoop – Hadoop, EcoSystem - Spatial Big Data System.	10
III	Introduction to Spatial Data Science - Spatial Data analysis - Mapping - Statistical Mapping - Univariate - Bivariate- Multivariate exploratory data analysis - Spatial Autocorrelation - Global Autocorrelation - Visualizing Autocorrelation -LISA and Local Moran - Other autocorrelation - Multi-variate LISA - LISA for binary variable.	15
IV	Software for Spatial Data Science : Basic R programming - R-Language – overview – Data types - Operators – Control structures – Looping statements – Functions – Strings – Vectors – List – Matrix – Arrays – Data Interfaces - Chart and Graphs – Statistics Operations – Data frames – Data Visualization – Basic Mapping. Software : GeoDa - GeoDaSpace - PySAL spreg API - spvcm - PySAL - CAST - Spatial Access package. Applications of Data Science and Spatial Data Science	15

V	Spatial Point Patterns Methodology and Applications with R: Point pattern concept - Point Pattern Intensity - Point pattern vs Intensity - Point Pattern Distance - Point Pattern K function - Point Pattern Local K -DBScan-Smoothing Rates -Scan statistics - Dimension Reduction Methods - Clustering Methods-Classical - Advanced methods.	10
References	Reference Books: 1. Spatial Point Patterns Methodology and Applications with R - Adrian Baddeley, Ege Rubak, Rolf Turner. CRC publications 2. Cluster Analysis, Brian S. Everitt . Sabine Landau Morven Leese . Daniel Stahl, 5th edition Wily publications. 3. Practical Data Scince with R, 2nd Edition, Nina Zumel and John Mount and Rachel Thomas, Manning Publications.	
	E-Resources: 1. Spatial Data Science: https://www.youtube.com/watch?v=JwHxJsesG2Y&list=PLzREt6r1NenmFyTw8v2JZpEE4PZGNi5Ht	
Course Outcomes	On completion of the course, students should be able to CO 1. Understand the Concept of Data Science and Statistics CO 2. Understand database management system and Spatial Database Managements system. . CO 3. Understand Spatial Data Science. CO 4. Understand R programming CO 5. Understand Point Pattern methodology .	

Mapping of Cos with PSOs :

CO	PSO				
	1	2	3	4	5
CO 1	1	2	3	2	3
CO 2	1	2	3	2	3
CO 3	1	2	3	2	3
CO 4	1	2	2	2	2
CO 5	2	3	1	2	3

Semester	II	**Course Code**	**21GISP0210**
Course Title	**Practical –III: Remote Sensing, Digital Image Processing and Photogrammetry**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	30%
Category	• Core Course		
Scope of the Course (may be more than one)	Basic Skill / Advanced Skill Skill Development Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • provide hands on experience on visual interpretation of different satellite images and digital image processing techniques.		

UNIT	Content	No. of Hours
I	1. Study of various visual Remote Sensing Equipments 2. Decoding of different aerial and satellite data 3. Interpretation of Black & White and Multi-color images 4. Interpretation of optical, thermal and microwave images 5. Generation of various thematic maps using image.	12
II	6. Streovision Test and Anatomy of pocket & Mirror Stereoscopes. 7. Interpretation of Aerial photographs 8. Decoding, Marking & Transfer of Principal Points, Base line drawing, Flight line marking, 3D Observation, Tracing details, Transfer the details to base map.	12
III	9. Reading and displaying satellite data from BIL, BSQ and BIP formats 10. Layer stacking and Generating True, False and Pseudo Colour Composite 11. Georeferencing the base image, Image to Image, Map to Image 12. Extracting / Subset, Area of Interest (AOI) 13. Measuring distance and area. 14. Mosaic	12

IV	15. Preprocessing - Geometric correction of satellite image 16. Enhancement using different filtering techniques, Image Fusion 17. Principal Component Analysis (PCA) 18. Band ratio, NDWI, NDSI, RVI, TNDVI, PRI, NDVI etc. 19. Classification (Supervised, Unsupervised, Hybrid, Fuzzy etc) 20. Accuracy Assessment 21. Change detection 22. Terrain Analysis	12
V	23. Layout Preparation 24. Hyper spectral Image Analysis 25. 3D visualization 26. SAR Image Processing 27. Exploration of various sites on UAV 28. Familiarization with hardware and software of UAV 29. Acquisition of satellite images: Theory in UAV mode 30. Processing of UAV images	12
Course Outcomes	On completion of the course, students should be able to do CO1. Interpret aerial photographs, satellite images CO2.Transfer of information from image to base map CO3.Preprocessing and enhancement of satellite data. CO4.Apply unsupervised and supervised classification techniques and apply & analyze the accuracy. CO5.Apply various Image Processing technique.	

Mapping of Cos with PSOs :

CO	PSO				
	1	2	3	4	5
CO 1	3	3	3	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	3	3

Semester	II	Course Code	**21GISP0211**
Course Title	**Practical- IV Spatial Data Science**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	New	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • to learn MYSQL, • to learn Spatial Data Science using R • to utilize them in GeoDa software.		

UNIT	Content	No. of Hours
I	**MySQL** 1. Introduction to MYSQL 2. Data Definition Language(DDL) commands 3. Data Manipulation Language (DML) 4. Sub Queries and Joins 5. Views 6. Procedures 7. Cursors 8. Triggers	12
II	**Spatial Data Science – LAB (Practical)** 9. R- Introduction 10. Filtering a data frame for specific entries 11. Selecting and renaming columns 12. Creating a simple features spatial object 13. Checking and adding/adjusting projection information 14. Dealing with missing data 15. Spatial join 16. Spatial aggregation 17. PDF file Manipulation - (Parsing, Merging, Creating)	12

III	**GeoDa Software** 18. Basic Mapping 19. Rate Mapping 20. Exploratory Data Analysis 21. Local Spatial Autocorrelation 22. Global Spatial Autocorrelation 23. Density-Based Clustering Methods 24. Cluster Analysis 25. Spatial Clustering	12
Course Outcomes	On completion of the course, students should be able to do CO1. Write queries in MySQL. CO2. Create R programs for Spatial Data Science CO3. Use GeoDa Software for spatial Data Science .	

Mapping of Cos with PSOs :

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	1	2	3	2	3
CO 2	1	2	3	2	3
CO 3	1	2	3	2	3

SEMESTER – 3

Second Year

Semester	III	Course Code	**21GISP0312**
Course Title	**Global Navigation Satellite System**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	40%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Understand the working principles of GNSS, • Provide knowledge on various GNSS systems • Analyze and correct the GNSS errors • Create database on geo co-ordinates using various GNSS techniques • Apply GNSS in various fields		

UNIT	Content	No. of Hours
I	GNSS: Definition - History of GNSS - advantages and limitations of GNSS - Segments of GNSS - Control segment - Space segment - User segment – Uses of GNSS.	9
II	GNSS: NAVSTAR GPS – GALILEO – GLONAAS- Beidou. Regional – IRNSS –- QZSS. Types of receivers - realization of channel – user community. GNSS Augmentation: WAAS – LAAS – EGNOS – MSAS – SNAS.	10
III	Errors: Ionospheric and atmospheric delays - satellite and receiver clock error - anti spoofing - selective availability - multi path - dilution of precision - Number and geometry of visible satellites - location of GNSS receiver - distance between base station and rover receiver - signal to noise ratio - occupation time at a point. Error correction methods	10
IV	GNSS surveying: Standalone & DGPS - Static method, Rapid static positioning method - Reoccupation method - Stop & go method - Kinematic positioning method - Relative advantages and disadvantages of these methods - Data transfer and analysis.	9
V	Applications: Surveying – navigation - aviation - vehicle tracking - military - Precision farming – Location based services.	10
	Text Books:	

References	1. Sathees Gopi et al., Advanced Surveying: Total Station, GPS, and Remote Sensing (2nd Edition), Pearson India Education Services Pvt. Ltd., Noida, 2019.
	Reference Books: 1. Hofmann – Wellenhof, Lichtenegger and Collins, GPS: Theory and Practice (5th Edition), SpringerWien, New York, 2015. 2. Alfred Et al., GPS Satellite Surveying (4th Edition), Wiley India Pvt. Ltd., New Delhi, 2018. 3. Michael Kennedy, 'The Global Positioning System and GIS: An Introduction', Taylor and Francis Inc. New York, 2002. 4. Satheesh Gopi, Global Positioning System Principles and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
	E-Resources: 1. http://www.maps-gps-info.com/ed-resources.html 2. http://www.gisdevelopment.net/tutorials/tuman004.htm 3. http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html
Course Outcomes	On completion of the course, students should be able to do CO1. Understand fundamental of GNSS. CO2. Understand different GNSS satellites and systems. CO3. Analyze the errors and various correction methods CO4. Create a database on geo coordinates CO5. Apply GNSS in various fields.

Mapping of Cos with PSOs:

CO	PSO				
	1	2	3	4	5
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	2	2	2	1	1
CO 5	3	3	3	1	1

Semester	III	Course Code	**21GISP0313**
Course Title	**Geoinformatics in Resource Management**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	40%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • apply various tools of Geoinformatics in recourse management.		

UNIT	Content	No. of Hours
I	Soil – importance – problems - soil erosion estimation using RUSLE. Land Classification System – FAO - USDA- land capability assessment – Land use / Land cover classification. Land use planning: Rural and urban - Land Reclamation – Land Information System.	10
II	Introduction – Water Conservation - water quality monitoring - Ground water investigation - artificial recharge zone identification – surface water harvesting structure - flood prediction model - sedimentation evaluation - watershed approach for natural resource management – runoff and hydrological modeling.	9
III	Agriculture: Spectral properties of crops - crop canopy - identification & inventory - Yield modeling - crop production forecasting - crop condition assessment and monitoring - Microwave RS for crop inventory & case studies - Precision farming. Forestry: Forest taxonomy - inventory of forestlands - forest types and density mapping - Forest stock mapping - factors for degradation of forest - Forest change detection and monitoring - Forest fire mapping & damage assessment - LiDAR remote sensing for Forest studies.	10
IV	Infra structure demand analysis - Transportation planning – mapping transportation - network – classification - Transportation interaction models – intelligent transportation systems – optimum route – traffic and parking studies - accident analysis. Water utility - electrical utility - telecommunication – tower spotting – Sitting a new facility - customer loyalty studies - health information	10

	system - Solid and liquid waste management - Crime Analysis: mapping crime data - hot spot analysis.	
V	Environmental types and components – Pollution: Air – Water – Soil and Noise – Environmental Impact Assessment - Environmental Information System - Environmental and ecological concerns – resource development in remote areas - impacts of anthropogenic activities Oceanography: Major issues/problem – wetland classification - Thematic maps on coastal resources – site suitability analysis for aquaculture – Fishery – coral reef – Coastal Regulation zone – Coastal aquifer modeling – Integrated coastal Zone Management.	9
References	Text Books: 1. Fundamentals of Remote Sensing, George Joseph. Universities Press (India) Pvt Ltd, 3-5-819 Hyderguda, Hyderabad 500 029. 2003. 433 pp.	
	Reference Books: 1. Nitish Dogra, Sangeet Srivastava, Climate Change and Disease Dynamics in India, The Energy and resources Institute (TERI), New Delhi, 2012. 2. Narayan Singh and Amit Kumar Thakur, Climate Change and Environmental Issues, The Energy and resources Institute (TERI), New Delhi, 2018. 3. Joshi PK and Singh TP., Geoinformatics for Climate Change Studies, The Energy and resources Institute (TERI), New Delhi, 2013. 4. Alan L., MD Melnick, Introduction to Geographic Information Systems for Public Health, Aspen Publishers, 1st Edition, 2002. 5. Amim Hammad, Hassan karimi, Telegeoinformatics: Location-based Computing and Services, CRC Press, 1st Edication, 2004 6. Allah Brimicomber, GIS Environmental Modeling and Engineering, Taylor and Francis, 2003 7. Van Dijk M.G.Bos, GIS and Remote Sensing Techniques in Land-And-Water-Management, Kluwer Academic Publishers, 2001. 8. Juliana Maantay, John Ziegler and John Pickles, GIS for the Urban Environment, ESRI Press, 2006. 9. Laura Lang, GIS for Health Organizations, ESRI Press, 2000. 10. Lisa Godin, GIS in Telecommunications Managements, ESRI Press, 1st Edition, 2001.	
	E-Resources: 1. https://www.pdfdrive.com/geostatistical-and-geospatial-approaches-for-the-characterization-of-natural-resources-in-the-environment-challenges-processes-and-strategies-d175603772.html 2. https://www.isprs.org/proceedings/xxxv/congress/comm7/papers/83.pdf 3. https://www.zef.de/fileadmin/user_upload/ApplicationsofRemoteSensingandGISinNaturalResourceManagement.pdf 4. https://egyankosh.ac.in/bitstream/123456789/39604/3/MGY-001-E-B4.pdf 5. https://www.esds.co.in/blog/gis-applications-in-utility-sector/ 6. https://www.researchgate.net/publication/329963373_Application_of_GIS_in_Planning_of_Facilitate_Infrastructure 7. https://www.esri.com/content/dam/esrisites/sitecore-archive/Files/Pdfs/library/brochures/pdfs/transportation-infrastructure.pdf 8. https://www.pdfdrive.com/landscape-analysis-and-visualisation-spatial-models-for-natural-resource-management-and-planning-lecture-notes-in-geoinformation-and-	

	cartography-d184489152.html
Course Outcomes	On completion of the course, students should be able to do CO1. Apply Geoinformatics in Land resource management CO2. Apply Geoinformatics in Water Resources Management CO3. Apply Geoinformatics in Agriculture and Forestry CO4. Apply Geoinformatics in Utility management CO5. Apply Geoinformatics in Environmental and Oceanography

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester	III	Course Code	**21GISP0314**
Course Title	**Geoinformatics in Disaster Management**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	30%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • apply various tools of Geoinformatics in disaster management.		

UNIT	Content	No. of Hours
I	Types of disaster – Natural: Earthquakes – Landslides - Volcanism - Tsunami-Cyclones – Floods - Drought - Forest Fire Man-Made Disasters: Nuclear Disasters - Chemical Disasters - Biological - Deforestation - Accidents - Disaster Management Concepts.	9
II	Vulnerability – Hazard – Risk Assessment - Natural Disaster Mapping, Management and mitigation using Geoinformatics Technology.	10
III	Disaster Management: Prevention - Preparedness and Mitigation - Damage assessment - Land use planning and regulation for sustainable development. Pre-disaster and post disaster planning for relief operations - Development of Disaster management plan.	10
IV	Disaster Response: Disaster Response Plan – Communication - Participation and Activation of Emergency Preparedness Plan - Logistics Management - Trauma and Stress Management - Rumour and Panic Management.	10
V	Emergency Support Functions and their coordination mechanism. Resource & Material Management. Management of Relief Camp. Rehabilitation, Reconstruction and Recovery - Information systems & decision making tools. Application of UAV in pre and post disaster planning.	9

References	Text Books: 1. Parag Diwan, A Manual on Disaster Management, Pentagon Earth, New Delhi, 2010. 2. Brian Romaszewski, Geographical Information Systems (GIS) for Disaster Management, CRC Press, New York, 2019. 3. Peter Van Oosterom et al., Geo-Information for Disaster Management, Springer (India) Pvt. Ltd., New Delhi, 2008.
	Reference Books: 1. Sisizlatanova & Andrea Fabbrijonathanli, Geometrics solutions for Disaster management, Springer Verlag, 2007. 2. C.EmdadHaque, Mitigation of natural Hazards & disasters, Klwuer Academic publishers group, 2005. 3. Linda C. Bottersll & ponald A.wilhite, From Disaster response to Risk management. Klwuer Acadamic publishers group, 2005. 4. Gerard Blokdijk, Disaster recovery planning and services, Gennaio publishers, 2008. 5. Mohamed Gad Large scale disasters : prediction, control and mitigation, Cambridge university press, 2008
	E-Resources: 1..https://www.pdfdrive.com/geoinformatics-applications-in-disaster-management-nidm-d15299133.html 2.https://www.researchgate.net/publication/345179571_Geographical_Information_System_GIS_for_Disaster_Management 3.https://www.isprs.org/proceedings/XXXIII/congress/part7/1609_XXXIII-part7.pdf 4.https://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/files/ch60.pdf
Course Outcomes	On completion of the course, students should be able to do CO1. Explain the concept of disaster and distinguish various natural and manmade disaster CO2 Apply the Geoinformatics technology in Natural Disaster mapping, mitigations and management CO3. Develop Disaster management plan using Geoinformatics technology CO4. Plan the Emergency support system CO5. Develop disaster management information system

Mapping of Cos with PSOs:

CO	PSO				
	1	2	3	4	5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester	III	Course Code	**21GISP0315**
Course Title	**Practical – V: Geoinformatics in Resources and Disaster Management**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	Revised	If revised, Percentage of Revision effected **(Minimum 20%)**	40%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to 1. collect data for preparation various thematic maps 2. generate base maps for various fields of GIS 3. assess the land and water resource management, disaster management, network and drainage analysis, environment management etc using the thematic maps.		

UNIT	Content	No. of Hours
I	Preparation of various geo-system layers: Drainage –slope - aspect – land use/ land cover – ground water level – lineament - soil – geology – geomorphology. Collecting GCPs using total station and DGPS. Rainfall - AQI – water quality data.	12
II	Land resource management: Change detection in various land use/ land cover types and cross tabulation - soil erosion estimation - Village GIS - urban sprawl.	10
III	Water resource management: Watershed delineation - Morphometric Analysis: Areal – Linear – Relief aspects - locating site for ground water potential and artificial recharge zone – identification of suitable site for constructing water harvesting structures - water quality assessment.	15
IV	Agriculture: Spectral properties of crops - crop canopy - identification & inventory. Forestry: Forest types and density mapping - Forest change detection and monitoring. Disaster management: flood – landslide – drought assessment.	15

V	Infrastructural demand analysis - Environmental management: Climate change – land surface temperature – sea level rise– air pollution monitoring.	12
Course Outcomes	On completion of the course, students should be able to do CO1. Prepare various thematic maps for various areas of applications CO2. Use various thematic maps in specific applications CO3. Apply the tools of GIS in various ways for different applications CO4. Analyze the output generated and interpret it	

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	1	3
CO 2	3	3	3	1	3
CO 3	3	3	3	1	3
CO 4	3	3	3	1	3

Semester	III	Course Code	**21GISP0316**
Course Title	**Practical-VI: Case Study in GIS / Remote Sensing / WebGIS**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course		If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Project		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Apply knowledge of Geoinformatics technologies in real world spatial problems and create/ develop models.		

UNIT	Content	No. of Hours
	▪ Identification of an issue in consultation with internal guide. ▪ Collecting of existing works/ resources/ literatures on the identified issues. ▪ Collecting primary and secondary information (remote sensing, GNSS, field visit etc). ▪ Analyzing the collected data/ information (Digital Image Processing, GIS, Geoinformatics software development etc). ▪ Identifying the solution. ▪ Suggesting management/ mitigation plan. ▪ Report writing.	60
Remarks	▪ The size of the case study may be between 50 and 70 pages, which is not inclusive of scripts and other appendices ▪ The case study should be submitted both in print form and digital form (pdf / crystal reports).	
Course Outcomes	On completion of the course, students should be able to do CO1. Apply the tools of GIS, DIP. Customization of software and WebGIS in solving spatial problems.	

SEMESTER – 4

Second Year

Semester	IV	Course Code	**21GISP0417**
Course Title	**Dissertation**		
No. of Credits	6	No. of contact hours per Week	12
New Course / Revised Course		If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills • Field Placement / Field Project • Internship		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Implement the above learned technologies for solving spatial related issues in real world scenario		

	Content	No. of Hours
	▪ Identification of a problem in consultation with internal guide ▪ Executing the work as per the instructions of both internal and external guide while incorporating any of the following activities or combination of activities ▪ GIS implementation and application ▪ Remote Sensing and Digital Image Processing application ▪ GNSS application ▪ Photogrammetry application ▪ LiDAR application ▪ UAV application ▪ Designing of GIS ▪ Map server design ▪ Development of Spatial model ▪ Development Geoinformatics software or such other related topics, which will give focus to Geoinformatics implementation	180
Remarks	▪ The size of the dissertation may be between 50 and 70 pages, which is not inclusive of scripts and other appendices ▪ The dissertation should be submitted both in print form and digital form (pdf / crystal reports).	

Semester	IV	Course Code	**21GISP0418**
Course Title	**Internship**		
No. of Credits	12	No. of contact hours per Week	24
New Course / Revised Course		If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Industrial Placement • Internship		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills • Field Placement / Field Project • Internship		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • provide working experience in an organization, institution, companies etc.		
	Content		No. of Hours
	• Carry out on-site internship programme in any one of the government organizations, academic & research institutes, public & private industries etc. working/applying Geoinformatics technologies • It demands submission of fortnight reports on learning process and execution of desired objectives.		360
Remarks	• The internship is evaluated internally by the content the reports and viva voce		

Elective – Discipline Centric

Semester	III	Course Code	**21GISP03D1**
Course Title	**Earth, Atmospheric, Ocean and Planetary Sciences**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Major Elective		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-1: (Remember) • K-2: (Understand) • K-3: (Apply)		
Course Objectives (Maximum: 5)	The Course aims to • Provide important concepts of basic geosciences		

UNIT	Content	No. of Hours
I	Mineralogy and petrology – structural geology and geotectonic – paleontology and its applications – sediment logy and stratigraphy – marine geology and pale oceanography – geochemistry – economic geology - Precambrian geology and crustal evolution – quaternary geology – applied geology.	9
II	Physical Geography: geomorphology – climatology – bio-geography – environmental geography – geography of India.	9
III	Geophysics: Signal Processing – field theory – numerical analysis and inversion – gravity and magnetic fields of the earth – palte tectonics and geodynamics – seismology elastic theory – gravity and magnetic methods – electrical and electromagnetic methods – seismic methods – well logging.	10
IV	Meteorology: Climatology – physical meteorology – atmospheric electricity – cloud physics – dynamic meteorology – numerical weather prediction – general circulation and climate modeling – synoptic meteorology – aviation meteorology – satellite meteorology.	10
V	Ocean science: Physical oceanography – chemical oceanography – geological oceanography – biological oceanography.	10
	Text Books:	

References	1. Dr. Surendra Kumar & RPH Editorial Board , Joint CSIR-UGC (NET) Earth, Atmospheric, Ocean and Planetary Sciences Exam Guide (Part B & C), January 2021, Ramesh Publishing House, New Delhi.
	Reference Books: 1. Mahapatra. G.B., A Textbook of Geology, CBS publisher, 2019. 2. Huggett, Fundamentals of Geomorphology , Taylor and Francis, 2016 3. W.M. Telford, Exclusive with Professional Books (Hyd) Applied Geophysics South Asian Edition, 2010 4. Willis Isbister Milham, Meteorology, Andesite Press, 2015 **5.** Savindra Singh, Oceanography, Pravalika Publications, 2013
	E-Resources: 1. Carl Willhelm Correns, Introduction to Crystallography and Petrology 2nd Edition, https://www.pdfdrive.com/introduction-to-mineralogy-crystallography-and-petrology-d169738500.html 2. Richard C. Selley, Robin Cocks and Ian Plimer, Encyclopedia of Geology, Five Volume Set, Volume 1-5 (Encyclopedia of Geology Series), https://www.pdfdrive.com/encyclopedia-of-geology-five-volume-set-volume-1-5-encyclopedia-of-geology-series-d184350405.html 3. Alan H. Strahler, Introducing Physical Geography, 6th edition, https://www.pdfdrive.com/introducing-physical-geography-6th-edition-d188301758.html 4. William Lowrie, Fundamentals of Geophysics, 2nd Edition, https://www.pdfdrive.com/fundamentals-of-geophysics-second-edition-e38471798.html 5. Geology, Mining, Climatology, Meteorology, Sediment logy, Earth Science, Oceanography, https://www.pdfdrive.com/geology-mining-climatology-meteorology-sediment-logy-earth-science-oceanography-e40744251.html **6.** Robert H Stewart, Introduction to Physical Oceanography, https://www.pdfdrive.com/introduction-to-physical-oceanography-e33277726.html
Course Outcomes	On completion of the course, students should be able to CO1. Explain the mineralogy, petrology. CO2. Understand physical geography and geophysics CO3. Explain the concept of meteorology CO4. Explain the concept of oceanography.

Mapping of Cos with PSOs :

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	1	1
CO 4	3	3	3	2	2

Semester	III	Course Code	21GISP03D2
Course Title	**Geoinformatics for Watershed Management**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	60%
Category	• Major Elective		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate)		
Course Objectives (Maximum: 5)	The Course aims to • introduce watershed management and watershed characteristics • acquire knowledge on use of GIS and Remote Sensing in watershed management • acquire knowledge on watershed evaluation		

UNIT	Content	No. of Hours
I	Watershed – definition – Watershed delineation and codification – watershed approach – advantages – watershed as a unit of planning - causes and consequences for watershed deterioration - Watershed management – principles and components of watershed management – approaches to watershed development.	9
II	Physical characteristics: Geomorphology – Topography – Hydrography - Concentration time – Isochrones. Morphometric analysis: Linear aspect – Areal aspect – Relief aspect.	9
III	GIS data sources & data structures - Watershed delineation – spatial perspective – representation surface and sub-surface.	10
IV	Watershed characterization and assessment – management planning – watershed restoration – resource mapping – identification of erosion prone zones – modeling sediment yield.	10
V	Monitoring & Evaluation: Depth of water table – cropping pattern – area under biomass – various Land use/ land cover – water body. Purpose – types of evaluation – factors affecting evaluation – understanding community participation — PRA methods of evaluation.	10

References	Text Books: 1. N.D. Mani, Watershed Management: Principles, Parameters and Programmes, Dominant Publishers and Distributors, New Delhi, 2005
	Reference Books: 1. Paul A.DeBarry, PE,PH,APSS, "Watersheds Process, Assessment and Management", Wiley Student Edition, New Jersy, 2004 2. Srivastava, O.N. and Y.V. Rao, "Impact of Integrated Wasteland Development Programme (IWDP) - A Study in Uttar Pradesh, National Institute of Rural Development, Hyderabad, 2001. 3. Raj Vir Singh, "Watershed Planning and Management", Yash Publishing House, Bikaner, 2001. 4. E.M. Tideman, " Watershed Management guidelines for Indian Conditions", Omega Scientific Publisher, New Delhi, 2006 5. J.V.S.Murty, "Watershed Management", New Age International, New Delhi, 2007
	E-Resources: 1. Watershed Management by Dr. T.I. Eldho, Department of Civil Engineering, IIT Bombay. For more details on NPTEL visit http://nptel.ac.in 2. Amel Moustafa Azab, Integrating GIS, Remote Sensing, and Mathematical Modeling for Surface Water Quality Management, 2012, https://www.pdfdrive.com/integrating-gis-remote-sensing-and-mathematical-modelling-for-surface-water-quality-management-in-irrigated-watersheds-unesco-ihe-phd-thesis-e165584308.html 3. Land Stewardship in the 21st Century: The Contributions of Watershed Management, https://www.pdfdrive.net/land-stewardship-in-the-21st-century-the-contributions-of-watershed-management-e36318879.html
Course Outcomes	On completion of the course, students should be able to o CO1. Discuss the approaches and components of watershed management. CO2. Explain the watershed characteristics. CO3. Apply the tools of GIS in watershed management CO4. Apply remote sensing technology in watershed management CO5. Monitor and evaluate the watershed program using the tools of PRA and Geoinformatics.

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	2	2	2
CO 2	2	3	2	1	2
CO 3	2	3	2	1	2
CO 4	2	3	2	2	2
CO 5	2	3	2	2	2

Semester	III	Course Code	**21GISP03D3**
Course Title	**Web Technology for Geoinformatics**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	80%
Category	• Major Elective		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • provides the basic knowledge about the Internet & Web Technology for Geoinformatics		

UNIT	Content	No. of Hours
I	**Basic principles involved in developing web site** - Planning process - Five Golden rules of web designing - Designing navigation bar - Page design - Home Page Layout - Design Concept - Basics in Web Design - Brief History of Internet - World Wide Web - Why create a web site - Web Standards - Audience requirement. **Introduction to HTML** - What is HTML - HTML Documents - Basic structure of an HTML document - Creating an HTML document - Mark up Tags - Heading Paragraphs - Line Breaks - HTML Tags - Elements of HTML - Introduction to elements of HTML - Working with Text - Working with Lists, Tables and Frames - Working with Hyperlinks, Images and Multimedia - Working with Forms and controls.	9
II	**Introduction to Cascading Style Sheets** - Concept of CSS - Creating Style Sheet - CSS Properties - CSS Styling(Background, Text Format, Controlling Fonts) - Working with block elements and objects - Working with Lists and Tables - CSS Id and Class - Box Model (Introduction, Border properties, Padding Properties, Margin properties) - CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) - CSS Color - Creating page Layout and Site Designs - Web Publishing or Hosting. **Introduction to Client Side Scripting** - Introduction to Java Script -	9

	Javascript Types - Variables - Operators - Conditions Statements – Loops - Popup Boxes - Events - Working with Arrays - Objects - Functions - Using Java Script in Realtime - Validation of Forms - Related Examples.-.	
III	**Java Script API for ARCGIS** - Overview - Key Features - Create Map - Data - Search – Routing -Core Concepts - Visualization - Building UI - Developing Tools.	10
IV	**Server-Side Scripting** using Python - Introduction- CGI - Running Serverside examples - Climbing CGI Learning - Saving State Information - HTML and URL Escapes - Transferring Files to client and server.	10
V	**Django** - Overview - Request and Response - Models and admin site - view and Templates - Forms and generic views - Static Files. **Flask** - Overview - Project Layout - Application Setup - Define and access Database - Handling Applicaion Errors - Debugging Application Errors -Deploy to Production **WebGIS**- System and Architecture - Techniques and Applications.	10
References	Text Books: 1. Laura Lemay et al., Mastering HTML, CSS & JavaScript Web Publishing, BPB Publications, New Delhi, 2019. 2. Mike McGrath, JavaScript: Create functions for the web (5th Edition), McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2016. 3. Programming Python, Edition 2 Mark Lutz, ORelilly publisher (Server Side Scripting 15th Chapter)	
	Reference Books: 1. Jon Raasch et al., Java Script and jQuery for Data Analysis and Visualization, Wiley India Pvt. Ltd., New Delhi, 2015. 2. Dane Cameron, HTML5, JavaScript and jQuery, Wiley India Pvt. Ltd., New Delhi, 2015.	
	E-Resources: 1. https://nptel.ac.in/courses/106/105/106105084/ 2. https://developers.arcgis.com/javascript/latest/ 3. https://www.djangoproject.com/start/overview/ 4. https://flask.palletsprojects.com/en/2.0.x/#	
Course Outcomes	On completion of the course, students should be able to CO 1. Understand the basics of websites and HTML CO 2. Understand basics of cascading style sheets CO 3. Understand the basic concepts on Javascript API for ArcGIS CO 4: Understand Server Side Scripting CO 5. Understand Django and Flask	

Mapping of Cos with PSOs:

CO	PSO				
	1	2	3	4	5

CO 1	2	3	3	2	3
CO 2	1	3	2	3	2
CO 3	2	3	3	2	1
CO 4	3	2	1	3	3
CO 5	2	1	3	2	3

Semester	III	Course Code	21GISP03D4
Course Title	**Google Earth Engine for Remote Sensing Applications**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Major Elective		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Explore the students to Google Earth Engine and its application in Remote sensing		

UNIT	Content	No. of Hours
I	Google Earth Engine for Remote Sensing Applications Introduction to Google Earth Engine platform - advance JavaScript for Google Earth Engine - Download satellite data (Landsat and Sentinel) - Apply image processing in downloaded data - import and export spatial data (Vector and Raster) - analysis geospatial data cloud - Spectral indices - maximul composites on big data on cloud- image classification land cover mapping basics in earth engine.	10
II	Introduction to Google Earth Engine - Sign up for Google Earth Engine - Interface of Google Earth Engine: Code Editor & Explorer - Short Introduction to Spatial and satellite data - Types of spatial data: vector and raster data - Introduction to raster data (satellite images) Difference between sensors and platforms- Introduction to Landstat Program of NASA - Introduction to Sentinel Program of ESA - Using cloud platform for spectral indices & land cover analysis Getting started with Javascript and geospatial analysis in Google Earth Engine - Overview of datasets in Earth Engine.	9
III	JavaScript: Introduction to JavaScript - Mapping and Reducing Collection landsat - Working with image collections and image visualization - Image visualisation Image Calculation and Map functions in Earth Engine - Introduction to	9

	image data: Landsat - Image Calculations - Single Image Calculations - C reate a composite and calculate NDVI - Zonal Statistics in Earth Engine - Maximum NDVI - image collection Landsat and NDVI - change default names for output image collection	
IV	Importing and exporting data- Introduction export image data - Importing ratser and vector files into Google Earth Engine - Image mosaicking, clipping, reprojecting and exporting as tiff to Drive - Geospatial Analysis in Google Earth Engine - spatial data and remote sensing images - Drought Monitoring - Image preprocessing Cloud masking of Sentinel 2 images - Normalized Difference Water Index for flood monitoring - Flood Mapping with Sentinel-2 and NDWI - Project - Flood Mapping Introduction to LU/LC Classification - Machine Learning - overview Land use land cover mapping - Supervised classification with Google Earth Engine - Unsupervised Image Classification and Image Compositing - Supervised land use mapping with Google Earth Engine and Random Forest - Image Classification .	10
V	Global Forest Cover Change - Map of Life - Global Forest Watch - Tiger Habitat Monitoring - Malraia Risk Mapping - Collect Earth - Global Surface Water - Remote Sensing for Land cover mapping using Google Earth Engine - • Learn to apply land use land cover classification using satellite data Land use land cover change detection analysis - Perform accuracy assessment of land use classifications - Download, and process satellite images - Learn digital image processing - Digitize reference training data - Understand satellite image bands and spectral indices - Predict new land use land cover products - Access global land use land cover products.	10
References	Text Books: 1. Spatial Analysis, GIS and Remote Sensing: Applications in the Health Sciences (2000), Donald P. Albert, Taylor & Francis, Year: 2000	
	Reference Books: 1. Programming Google App Engine with Java, Sanderson, Dan, O'Reilly Media, Year: 2015 2. Programming Google App Engine with Python: Build and Run Scalable Python Apps on Google's Infrastructure, Dan Sanderson O'Reilly Media, Year: 2015	
	E-Resources: 1. https://earthengine.google.com/	

Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept Earth Engine and Java Script CO2. Learn about Unsupervised classification CO3. Learn about Supervised classification CO4. Understand Change Detection analysis CO5. Apply Google Earth Engine in areas of application of remote sensing

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	3	2	3
CO 2	1	3	2	3	2
CO 3	2	3	3	2	2
CO 4	3	2	1	3	3
CO 5	2	1	3	2	3

Modular Course

Semester		Course Code	21GISP00M1
Course Title	**Spatial Decision Support System**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	20%
Category	• Modular course		
Scope of the Course (may be more than one)	• Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • exposes the students to decision making and concepts of spatial decision support system		

UNIT	Content	No. of Hours
I	Introduction to Decision Making - Concept and Characteristics of Spatial Decision Support Systems (SDSS) – Architecture of SDSS GIS – Types of Spatial Decisions – Spatial – Decision Making Problems – Spatial Decision Making Process – Need for Decision support system - Spatial Decision Support System (SDSS) and	6
II	Decision variables - Concept – Deterministic, Random - Decision Alternatives and Constraints - Efficiency and Effectiveness of Decision Making	5
III	Concept of Estimating Weights – Ranking Methods – Rating Methods – Pairwise comparison methods – Trade off analysis methods	6
IV	Concept and types of Multi-attribute Decision modeling – Multi objective Decision Modeling – Sensitivity Analysis. Models of SDSS: Boolean Overlay - Weighted Linear Combination – AHP – Ordered Weighted Approach – ANN – Cellular Automation – Fuzzy modeling SDSS software: ArcGIS Modelbuilder – ERDAS Imagine – Open SDSS – Open Source Software	6

V	SDSS Applications: Natural Resource Management – Environmental Management – Agriculture – Utility/ Communication/ Energy and Transportation – Business - Land Suitability Analysis – Education and Health Care Resources location – Water Resources Management.	7
References	Text Books: 2. Ramanathan Sugumaran and John Degroote, Spatial Decision Support Systems-Principles and Practices, CRC Press, Taylor and Francis Group, USA, 2011.	
	Reference Books: 1. Bonczek, R.H., C.W. Holsapple, and A.B. Whinston, 1981, Foundations of Decision Support Systems, Academic Press, New York. 2. House, W.C. (ed.), 1983. Decision Support Systems, Petrocelli, New York. 3. Jenson, J.R. 2000, Remote Sensing of the environment – An Earth Resource Perspective, Prentice Hall Inc. 4. Malczewski, J. 1999, GIS and Multicriteria Decision Analysis, John Willey and Sons, New York. 5. Raghu Ramakrishnan, 2002, Database Management Systems, Johannes Gehrke, McGraw- Hill.	
	E-Resources: 1. Ramanathan Sugumaran and John Degroote Spatial Decision Support Systems: Principles and Practices, CRC press, http://www.gisresources.com/wp-content/uploads/2014/06/spatial-decision-support-system.pdf	
Course Outcomes	On completion of the course, students should be able to do CO6. Understand the concept, architecture and frame work of SDSS and decision variables CO7. Learn about various ranking, rating and comparison methods involved in decision modeling CO8. Gain knowledge on types of decision modeling CO9. Apply the SDSS in specified areas	

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	2
CO 2	1	2	2	1	2
CO 3	2	1	2	1	2
CO 4	1	1	2	1	2

Semester		Course Code	**21GISP00M2**
Course Title	**Open Source Software**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised	If revised, Percentage of Revision effected **(Minimum 20%)**	60
Category	• Modular course		
Scope of the Course (may be more than one)	• Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • the open source software available for research and development.		

UNIT	Content	No. of Hours
I	Introduction to Open source: Importance – Advantages – Applications. Open source operating systems LINUX: Introduction – General Overview – Kernel Mode and user mode – Process – Advanced Concepts.	6
II	Open source Software: GIS: Openjump – GRASS – QGIS - SagaGIS Image Processing: ILWIS, SciLab. GIS Database: PostGIS. Compilers: Python, R. Scripting Language: Java Scripting. Mark-up languages: HTML - WebODM Compare QGIS – ArcGIS –SagaGIS - OpenJump.	6
III	Web Mapping with Open source tool kit - Introduction to Web mapping – Merits and demerits of web mapping - Different kinds of web mapping – Architecture of Web GIS - Web GIS applications Basic web-development language - Mapping Libraries and other utilities - Map Servers - Backend and Data base - Frontend libraries - Spatial Data Infrastructure (SDI) Platforms - Project on Web mapping: A Panchayat GIS will be created by different groups.	6
IV	Mobile GIS apps: Weather apps, Wind speed/direction, Pollution apps, Location/navigation apps, Data collection apps, Geo data collect, Geo area Map, Geo Camera - ArcGIS Earth - ArcGIS Collector - ArcGIS Workforce – Google Earth Engine.	6

	Mobile mapping -Fundamental of mobile mapping, application of GPS in resources surveys and mapping.	
V	GIS Customization Programming: GIS Customization - Needs of Scripting Language – Advantage of Macro Scripting – Sample Case studies.	6
References	Text Books: 1. Markus Neteler, Helena Mitasova, Open Source GIS: A GRASS GIS Approach, Edition, Springer 2007.	
	Reference Books: 1. Neteler, M and H.Mitasova, Open Source GIS. A GRASS GIS Approach, Kluwer Academic Publishers, Boston, USA/London, UK, 2008. 2. Qgis: https://www.packtpub.com/application-development/mastering-qgis 3. Machtelt Garrels Introduction to Lmux beginner Guide 4. Pride Fu, Jiulus S : WebGIS: Principle & Application, ESRI Press, 2011	
	E-Resources: 1. Linux Operating System: http://nptel.ac.in/courses/106106144/ 2. Javascript: http://nptel.ac.in/courses/106105084/25 3. SciLab: http://nptel.ac.in/courses/113101002/5 4. R programming: http://nptel.ac.in/courses/102101056/9	
Course Outcomes	On completion of the course, students should be able to do CO1: Understand the concept and protocols in Open Source Software and Describe about various open source operating system. CO2: Understand various Open Source Software. CO3: Understand and create WebGIS. CO4. Know about GIS related mobile apps. CO5: Understand Customisation of GIS	

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	2	3	2	3
CO 2	3	1	3	2	3
CO 3	1	3	2	3	2
CO 4	1	2	3	1	3
CO 5	3	3	1	2	3

Semester		Course Code	21GISP00M3
Course Title	**LiDAR and its Applications**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected **(Minimum 20%)**	40%
Category	• Modular course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • explores the open source software available for research and development.		

UNIT	Content	No. of Hours
I	LASER, LiDAR –properties – working principle of LiDAR – Discrete and full-wave form LiDar – Types of LiDAR based on Carrier – Types based on pulse emitted – Discrete Vs Full – Waveform LiDAR - Applications – Advantages and Disadvantages – Space borne and airborne LiDAR missions – Typical parameters of a LiDAR system.	6
II	Principle of Laser Altimetry – Components of the system – GNSS, IMU, LASER, LiDAR data formats – Terrain Mapping Laser Configuration – Ocean bathymetry Laser Configuration - Limitations of the system.	6
III	GNSS and IMU data processing – Strip Adjustment – Geometric Correction – Data quality enhancement – Digital Surface Model – Filtering – Ground Point Filtering – Digital Elevation Model. Interpretation of LiDAR: Introduction to DEM – DTM – Canopy Height. Tree Delineation using Watershed Algorithm.	6
IV	Applications of LiDAR: Hydrology, Disaster Mitigation and Management – 3D city models – Telecommunication – Biodiversity – Forest Health Monitoring – Urban Planning – Wood Trade – Archeology – Automated Driving.	6
V	Other types of LiDAR System: Multi- Spectral – Atomospheric – Bathymetric LiDAR. Modeling – Coastal Zone Bathymetry Mapping – Feature extraction,	6

	vectorisation – Surface and land use classification. Orthophoto rectification using LiDAR – Integrated LiDAR and Digital Photogrammetry Techniques – Integration of LiDAR DEM with other hyper spectral data.	
References	Text Books (with chapter number & page number, wherever needed): 1. Altimetry- Principles and Applications- Mathias Lemmens, CRC Press.	
	Reference Books: 1. Digital Photogrammetry - Yves Egels and Michel Kasser, CRC Press. 2. Laser Manual of Aerial Survey, Primary Data Acquisition- Roger Read and Ron Graham 3. Digital Terrain Modeling: Principles and Methodology- Zhilin Li Qing Zhu, Christopher Gold, CRC Press.	
	E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.) 1. Pinliang Dong & Qi Chen, LiDAR Remote Sensing and Applications, 2018, CRC Press, https://www.pdfdrive.com/lidar-remote-sensing-and-applications-d158479644.html 2. Light Detection and Ranging (LiDAR) Technology Evaluation, https://www.pdfdrive.com/light-detection-and-ranging-lidar-technology-evaluation-d26826416.html 3. Lidar 101: An Introduction to Lidar Technology, Data, and Applications, https://www.pdfdrive.com/lidar-101-an-introduction-to-lidar-technology-data-and-d17380303.html	
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept and protocols in Open Source Software CO2. Describe about various open source operating system CO3. Summarise functions of Geo apps CO4. Understand the web mapping and web servers CO5. Work on sample case studies using open source software	

Mapping of Cos with PSOs:

CO	PSO				
	1	2	3	4	5
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	1	1
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester		Course Code	21GISP00M4
Course Title	**Drone Image Processing**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	
Category	• Modular course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Explain the concept of Drone image processing		

UNIT	Content	No. of Hours
I	UAV/Drone Image Processing for GIS data generation i.e Aerial Triangulation, Orthophoto, 3D Point Cloud, DSM, DTM, 3D Mesh Model and Contour. Comprehensive workflow to process UAV/drone images that will save time during image processing. The basic theory behind UAV/Drone image Processing and Hardware/Software Requirement.	6
II	UAV/Image pre processing step that involves Geotagging, Remove Geotagging, Point Shape File Creation, Rename the images using ExifTOOL and QGIS. UAV/Drone Image Processing Platforms such as Desktop, Cloud, Network Processing and Batch Processing.	6
III	Stereo Satellite Image Processing. Working with Ortho photo, Color correction, Seam line editing, 3D point Cloud classification, Conventional Ortho generation and Contour generation.	6
IV	Processing Oblique and Nadir Images for High Accurate 3D Model Generation. Volume Calculation and Earthworks for Civil or Mining Engineer. 360^{o} panorama generation for UAV/Drone Spherical Images	6
V	Processing RTK/PPK images and their image acquisition theory Export Aerial Triangulation Result as Stereo Setup for Stereo Compilation.	6

	Accuracy Assessment Method (Relative, Absolute and Survey Grade) for UAV/Drone data product.	
References	Text Books (with chapter number & page number, wherever needed): 1. Amy E. Frazier, Kunwar K. Singh, Fundamentals of Capturing and Processing Drone Imagery and Data, CRC Press, 2021, ISBN 9780367245726.	
	Reference Books: 1. John R. Jensen, Drone Aerial Photography and Videography: Data Collection and Image Interpretation, 2018. 2. Felipe Gonzalez Toro and Antonios Tsourdos, Mdpi AG, UAV-Based Remote Sensing: Volume 2, 2018	
	E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.) 1. Felipe Gonzalez Toro & Antonios Tsourdos, UAV or Drones for Remote Sensing Applications, https://www.pdfdrive.com/uav-or-drones-for-remote-sensing-applications-e176213164.html 2. Henri Eisenbeiss, UAV Photogrammetry, https://www.pdfdrive.com/uav-photogrammetry-e33411397.html 3. Pablo Zaroo-Tejada, High resolution hyperspectral and thermal remote sensing from UAV, https://www.pdfdrive.com/high-resolution-hyperspectral-and-thermal-remote-sensing-from-uav-e14457225.html	
Course Outcomes	On completion of the course, students should be able to do CO1: Understand data generation using Drone CO2: Understand the pre processing steps and platforms for drone image processing CO3: Explain the concept of stero satellite image processing. CO4: Apply the UAV in 3D model, civil engineering etc. CO5: Check and export the output.	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	2	3	4	5
CO 1	2	3	3	3	2
CO 2	2	3	3	1	2
CO 3	3	2	3	1	2
CO 4	2	3	3	1	2
CO 5	2	3	3	2	2

Value Added Courses

Semester	II	**Course Code**	21GISP2VA1
Course Title	**Advanced Surveying**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Value added course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • Introduces the advance tool of surveying viz., total station, DGPS, UAV		

UNIT	Content	No. of Hours
I	Introduction to Total Station: Principle and Function. REM, RDM, Use of Total station for data processing and analysis.	6
II	Introduction to Differential GPS (DGPS): Principle and Function. Duel and Single Frequency DGPS, RTK and Static Surveys in DGPS, Use of DGPS in Topographical Survey. Comparison of total station with DGPS in Topographical Surveying	6
III	Introduction to Unmanned Aerial Systems (UAS), UAV (Unmanned Aerial Vehicle): Principle and Functions, Drone survey.	6
IV	Total station Survey and data processing. Area selection, setup of instrument at base station and collecting points using reflector.	6
V	DGPS setting of Instruments at base and rover. DGPS Survey and Data Processing. Generation of digital elevation model (DEM)	6

References

Text Books:

3. Sathees Gopi et al., Advanced Surveying: Total Station, GPS, and Remote Sensing (2nd Edition), Pearson India Education Services Pvt. Ltd., Noida, 2019.

Reference Books:

5. Hofmann – Wellenhof, Lichtenegger and Collins, GPS: Theory and Practice (5th Edition), SpringerWien, New York, 2015.
6. Alfred Et al., GPS Satellite Surveying (4th Edition), Wiley India Pvt. Ltd., New Delhi, 2018.
7. Michael Kennedy, 'The Global Positioning System and GIS: An Introduction', Taylor and Francis Inc. New York, 2002.
8. Satheesh Gopi, Global Positioning System Principles and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

	E-Resources: 4. http://www.maps-gps-info.com/ed-resources.html 5. http://www.gisdevelopment.net/tutorials/tuman004.htm 6. http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept about total station CO2. Understand the concept of DGPS and its working principle. CO3. Understand the technology of UAV CO4. Process the data derived from total station. CO5. Process DGPS surveying and its data.

Semester	II	**Course Code**	21GISP2VA2
Course Title	**Planetary Remote Sensing**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Value added course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • introduce the technology of remote sensing in planetary science.		

UNIT	Content	No. of Hours
I	Universe and Solar System: Origin of Universe - Big Bang and Steady state theories, Solar System - planets, satellites asteroids, meteorites and comets and internal differentiation of the planets.	6
II	Terrestrial Planets: Geology and geophysics of terrestrial planets: earth, mars, venus and mercury; physical properties, composition, mineralogy and petrology of the planets and the Moon	6
III	Planetary Atmosphere: Exo- and Endogenic processes associated with origin and internal evolution of planets – planetary volcanism, craters, elemental composition; mineralogy and petrology; thermal, seismic and magnetic properties	6
IV	Remote Sensing for Planetary Geology: Approaches to Remote Sensing analysis of the planetary surfaces; applications derived from interaction of electromagnetic radiation (X-ray, gamma-ray, visible, near-IR, mid-IR, radar).	6
V	Planetary Exploration Missions: Past, present and future missions **-** Analyses and Interpretation of data gathered through various missions: identification of morphological features	6
References	Text Books: 1. Bo Wu, Kaichang Di, Jürgen Oberst, Irina Karachevtseva**,** Planetary Remote Sensing and Mapping, CRC Press, 2018	
	Reference Books: **1.** Shuanggen Jin , Planetary Geodesy and Remote Sensing, CRC Press, 2015	

	E-Resources: 2. Introduction to Planetary Geomorphology, https://www.pdfdrive.com/introduction-to-planetary-geomorphology-e166013877.html **3.** Planetary Remote Sensing and Mapping, https://www.pdfdrive.com/planetary-remote-sensing-and-mapping-e190135569.html
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the basic information about to universe and solar system. CO2. Understand the concept of terrestrial planets CO3. Understand the planetary atmosphere CO4. Apply remote sensing for planetary geology CO5. Apply remote sensing in planetary exploration missions.

Semester	II	Course Code	21GISP2VA3
Course Title	**Satellite Meteorology**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Value added course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the Course	• K-1: (Remember) • K-2: (Understand) • K-3: (Apply)		
Course Objectives (Maximum: 5)	The Course aims to • introduce the technologies of remote sensing in meteorology		

UNIT	Content	No. of Hours
I	Basics – Concepts in Satellite Meteorology – Conventional Direct Measurements – Indirect Methods and Remote Sensing	6
II	Weather Satellites and Sensing Systems – Orbit Types and Altitudes – View Angle and Implications – INSAT and KALPANA – TRMM and GPM and others – American and European Missions, availability of data and derived data sets.	6
III	Data Records and Applications – Active and Passive Sensor Data – Microwave Sensors and Applications – Altitude. Wind. Temperature and Wave Measurements and Sensors – AWS Global Network in Measurements.	6
IV	Meteorological Applications – Oceanographic Applications – Weather Forecasting – Aviation Meteorology – Agriculture and Irrigation Management – Meteorology in Transportation Industry – Business and Trade Application	6
V	Management and Monitoring : Satellite Meteorology in Welfare Management – Cyclone Warning Systems – World Precipitation and Warming – Sea level Monitoring – Ice and Snow – Flood and Storm Surge Warning Systems – Storms – Wild Fires and Volcanic Ash.	6

References	Text Books: 1. R R Kelkar, Satellite Meteorology, 2nd Edition, BS Publications,2017
	Reference Book: 1. Text book on Satellite Meteorology, https://metnet.imd.gov.in/imdetp/lecture_notes/course10/LN_10_55_Lecture%20on%20Satellite%20Meteorology.pdf

	E.Resources: 1. Remote Sensing Applications with Meteorological Satellites, https://cimss.ssec.wisc.edu/rss/brienza/source/AppMetSat12.pdf 2. Satellite Meteorology, http://iprc.soest.hawaii.edu/users/yqwang/EOLSS_satellite.pdf
Course Outcomes	On completion of the course, students should be able to CO 1. Understand the basic concept of satellite meteorology CO 2. Understand different types of weather satellites and sensors CO 3. Understand data records and applications. CO 4 Apply satellite data in different fields CO 5. Apply the technology in management and monitoring.

Semester	II	Course Code	21GISP2VA4
Course Title	**Land Use/ Land Cover Mapping using Google Earth Engine**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Value added course		
Scope of the Course (may be more than one)	• Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • exposes the students to know about Earth engine and its applications.		

UNIT	Content	No. of Hours
I	Introduction to Earth Engine - Explore Earth Engine - Sign Up with Earth engine. JavaScript code Editior - JavaScript Syntax - Code Editior	6
II	UnSupervised Classification - Clustering - Training Reference Data Supervised Classification with Landsat - Processing Landsat Data - Classification with Landsat - Confusion Matrix	6
III	Supervised classification with Sentinel - Processing Sentinel Data - Classification with sentinel - Confusion matrix Supervised Classification with MODIS - Processing MODIS Data - Classification with MODIS - Confusion Matrix	6
IV	Change Detection Analysis - Water Change Analysis - Forest Change Analysis - Assignment:Water ZChange ANalysis	6
V	Global Land Cover Products - Globe COver - NLCD Land COver.- Case Study.	6

References	Text Books: 1. Google Earth Engine Applications, Lalit Kumar and Onisimo Mutanga, MDPI publications
	Reference Books: 1. Programming Google App Engine with Java, Sanderson, Dan, O'Reilly Media, Year: 2015 2. Programming Google App Engine with Python: Build and Run Scalable Python Apps on Google's Infrastructure, Dan Sanderson O'Reilly Media, Year: 2015

	E-Resources: 1. https://earthengine.google.com/
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept Earth Engine and Java Script CO2. Learn about Unsupervised classification CO3. Learn about Supervised classification CO4. Understand Change Detection analysis CO5. Understand Global Land Cover and Analysis case study.